MASSACHUSETTS MARINE FISHERIES INSTITUTE

Environmental Change Workshop Summary

INCORPORATING ENVIRONMENTAL CHANGE IN ASSESSMENTS AND MANAGEMENT

May 7-8, 2013; UMass School for Marine Science & Technology, 200 Mill Road, Fairhaven, MA

Scientists and fishermen from throughout New England contributed to a workshop aimed at identifying ways to account for environmental change in fishery science and management of New England groundfish. The workshop was hosted by The Massachusetts Marine Fisheries Institute as the first in a series that forms an end-to-end review of groundfish stock assessments and management. The workshop identified changes in the ocean environment that have occurred in the New England region, with consideration of future changes and effects on fish stocks. Considering case studies from New England and other regions, methods to account for environmental effects were reviewed as well as the information needed to apply such methods to New England groundfish assessments.

Profound changes in the regional marine environment were documented including:

- atmospheric patterns (e.g., recent reversal of the North Atlantic Oscillation),
- oceanography (e.g., extremely warm temperatures in 2012, recent indices of the Atlantic Multidecadal Oscillation are near record high, increased winter heat budget in the Gulf of Maine, acidification, fresher water on Georges Bank and saltier water in the deep basins of the Gulf of Maine, increasing stratification of the water column in the Gulf of Maine and on the Scotian Shelf),
- and ecology (e.g., increased productivity of phytoplankton, declining zooplankton biomass, shifts in zooplankton species composition and smaller size distribution, habitat degradation and increases in many important predator populations).

Many of the recently observed changes in the marine ecosystem are expected to continue.

Fish populations and their productivity are influenced by these environmental changes from the top-down (i.e., the effect of predators that eat fish) and bottom-up (i.e., physical habitat and production of species eaten by fish). The fish community has been shifting toward more warm-water species and a smaller size distribution. Spatial distributions of species are also changing, generally northward and deeper. Growth patterns of many groundfish species have changed so that size-at-age and condition of individuals is declining. Reproductive dynamics are also changing for some species and are influenced by ecosystem factors. Behavior is also affected by thermal habitats, increasing swimming speed and endurance and possibly catchability by mobile fishing gear. Complex changes in the marine environment affect the productivity of many important groundfish stocks, and such changes should be accounted for in the science and management system.

Application of several general approaches to fishery science and management as well as specific stock methods for stock assessment of New England groundfish were recommended:

1. Alternative stock assessment modeling approaches should be evaluated, specifically multispecies models, simpler index-based methods that have fewer assumptions of constant environmental conditions, as well as biomass dynamics and stock-recruitment models with environmental covariates.
2. Formal model selection should be used to evaluate information from multiple modeling approaches, and when several alternatives are likely, multi-model inference should be applied.

3. Assumptions or estimates of natural mortality should be informed with estimates of consumption, analysis of tagging data and patterns in weight-at-age.
4. The effect of changing spatial distributions should be considered in the development of more informative survey indices (e.g., informing changes in catchability, standardizing surveys to account for variations, post-stratification of surveys to account for changing habitats).
5. Environmental change should be more carefully considered in stock projections and reference points such as overfishing definitions and rebuilding targets.
6. Both empirical and mechanistic approaches should be developed for projecting future recruitment or stock trends.
7. A process and more effective methods for including information from fishermen (e.g., catch rates, study-fleets, industry-based surveys, tagging studies, ecological knowledge) into stock assessment modeling should be developed.
8. In the context of rapidly changing environments and fish productivity, the fishery science and management process should be more flexible and responsive. For example, more frequent assessments, possibly with simpler models or a more streamlined process would be more responsive to changing conditions.
9. A transition to Ecosystem-Based Fishery Management would explicitly incorporate environmental change into fishery science and management.
10. Management strategy evaluation with broad stakeholder input should be used to develop alternative stock assessment methods and management procedures.

Much of the information required for these recommended methods are currently collected and available for application, but more information may be needed. Recognizing that the marine environment is rapidly changing, a greater commitment to ecosystem monitoring is needed. Rather than layering additional sampling onto current sampling programs, an environmental monitoring system should be developed to meet the needs of the science and management process. The development of an environmental monitoring system should review all available information (including underutilized resources), identify the information needed to support stock assessments and management, and promote data sharing, access, availability and communication among scientific disciplines. The monitoring system should include broader ocean observations, alternative survey methods, fishermen-collected data, representative diet data from fish predators, information necessary to estimate consumption of important fish species by marine mammals, tagging studies to estimate natural mortality, monitoring of pathology for epidemiological studies, and data to inform the National Environmental Policy Act process for evaluating environmental impact from fishing and non-fishing activities. Unless increased funding is available, the development of an environmental monitoring program and the transition to Ecosystem-Based Fishery Management will require prioritization, increased efficiencies and possibly reallocation of budgets or more extensive reprogramming.